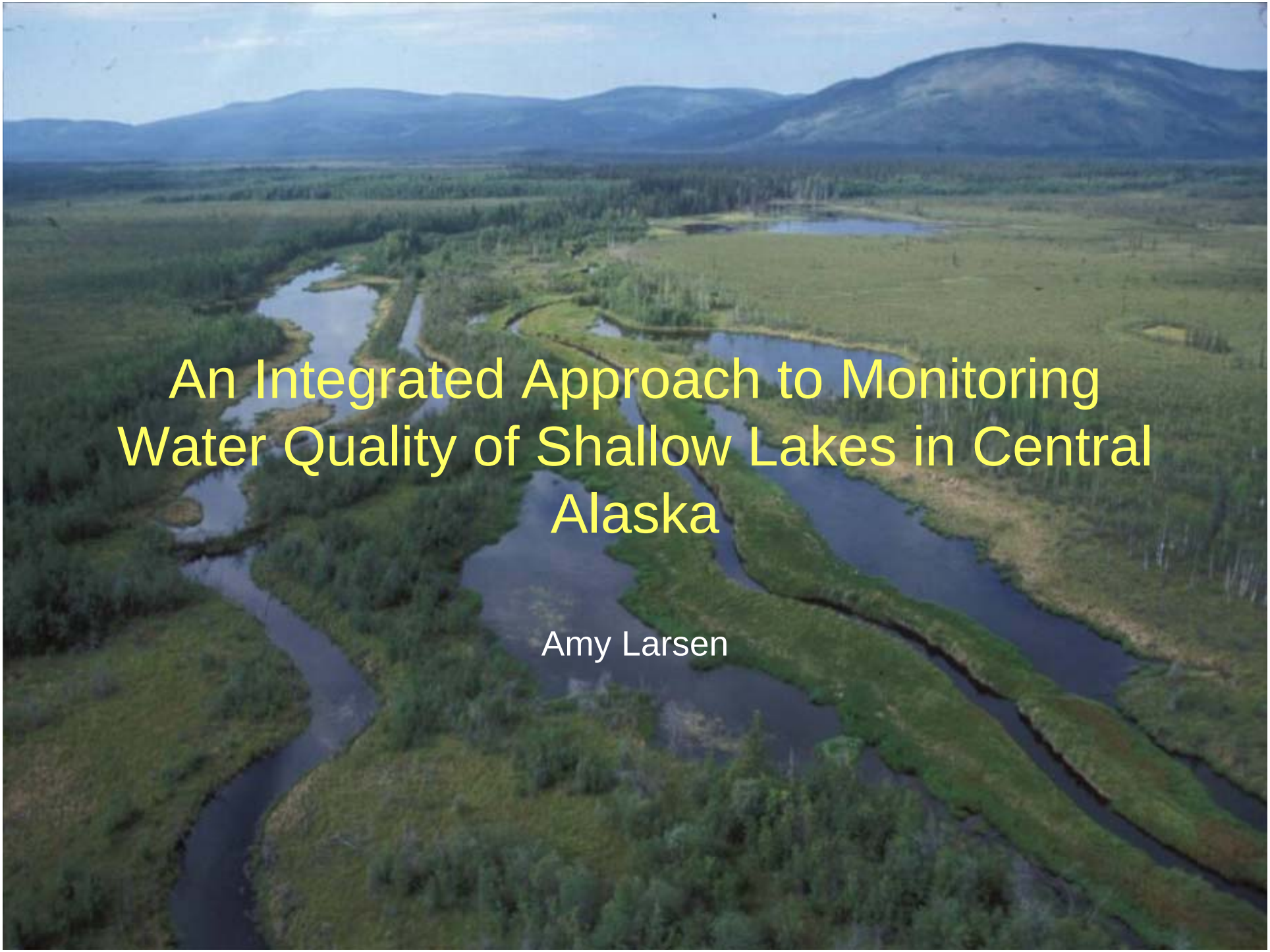
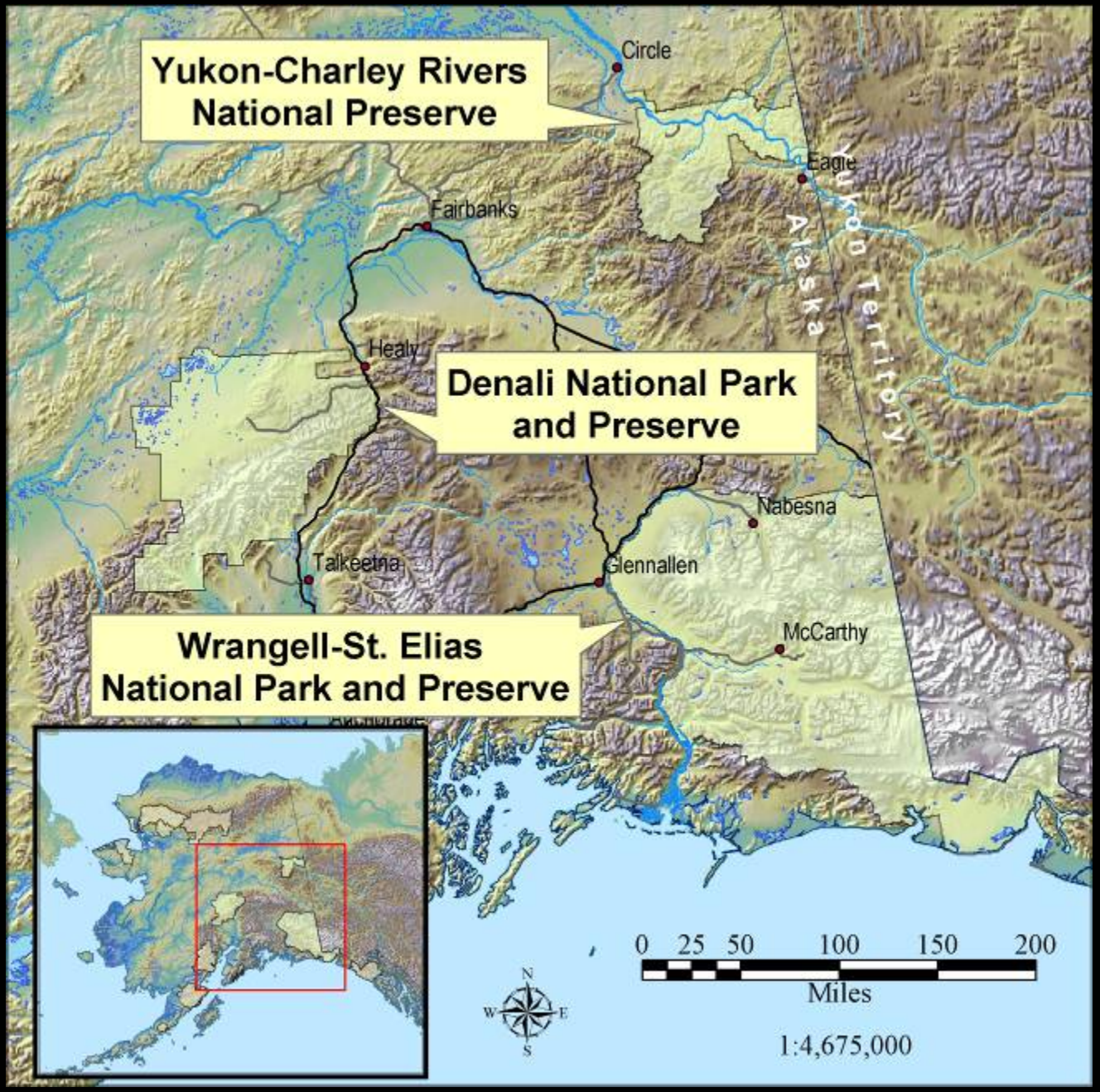


An Integrated Approach to Monitoring Water Quality of Shallow Lakes in Central Alaska

Amy Larsen


Yukon-Charley Rivers
National Preserve
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Denali National Park
and Preserve
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Shallow lakes are a natural choice for monitoring

- Occur extensively throughout the network
- Small ecosystems where ecological change can be easily tracked
- Integrate and reflect terrestrial as well as aquatic conditions.
- They are relatively easy to sample
- They have distinct boundaries

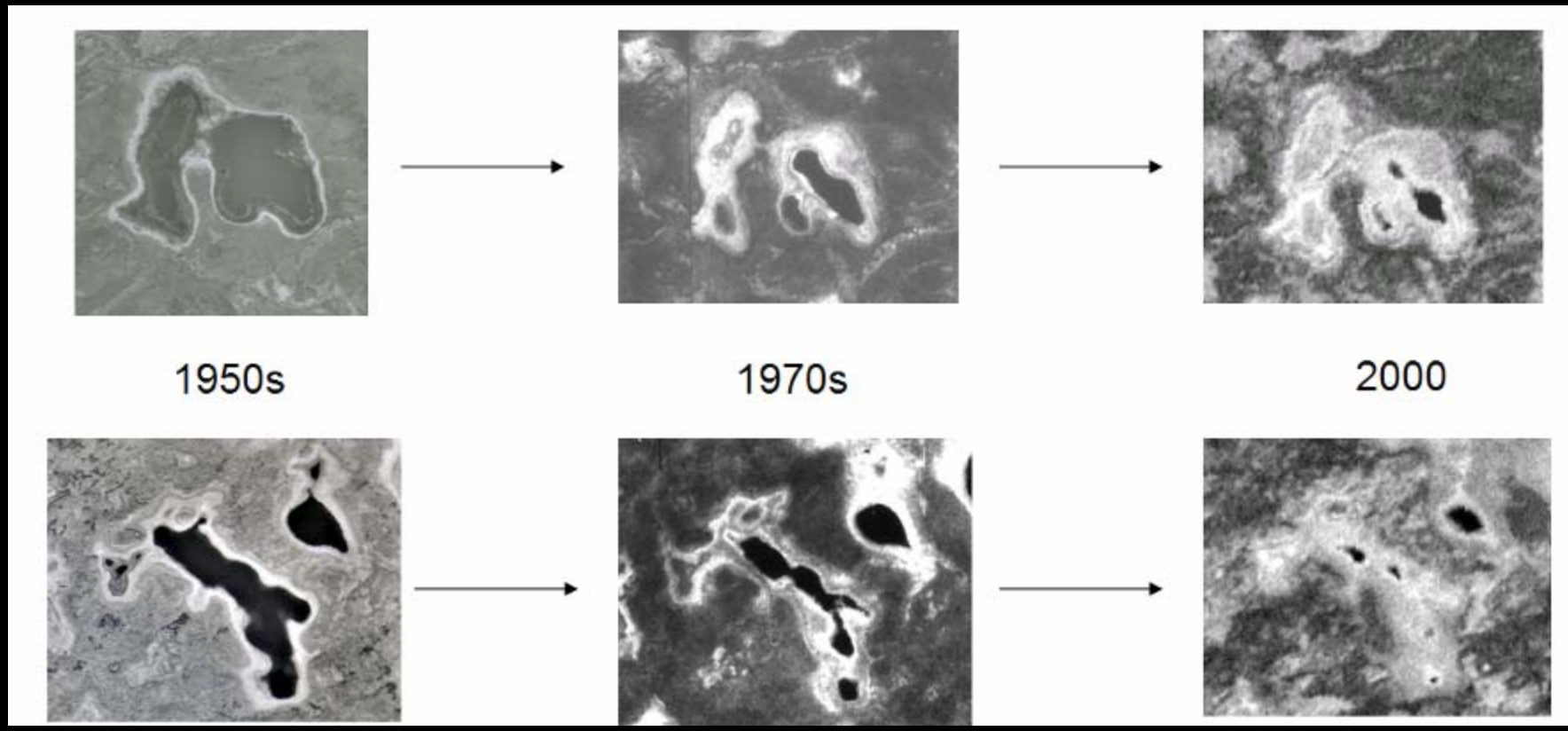
Shallow lakes serve diverse ecological functions

- biogeochemical cycling by acting as sources, sinks and transformers of nutrients
- generally high rates of primary and secondary production
- high biodiversity
- provide critical habitat to invertebrates, fish, waterfowl, furbearers and amphibians

Little is known about the physical, chemical and biologic factors in these systems

These systems appear to be changing

Reduced lake surface area from Yukon Flats, NWR



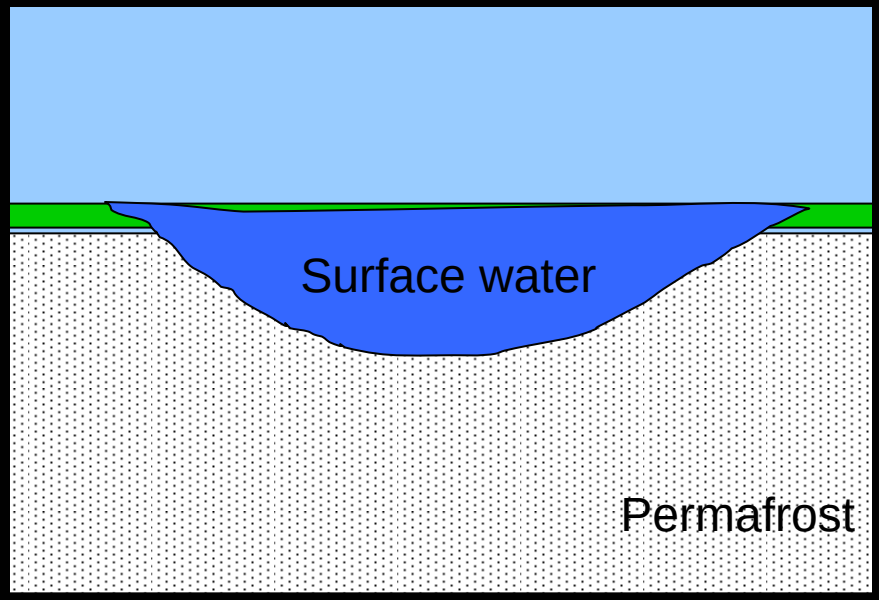
Alaska's future climate

- Climate models predict strong warming in Alaska increases of 1.5-5^{o}F by 2030
- Greatest warming during winter months
- Project 20-25% increases in precipitation
- Also project increased evaporation despite precipitation increases

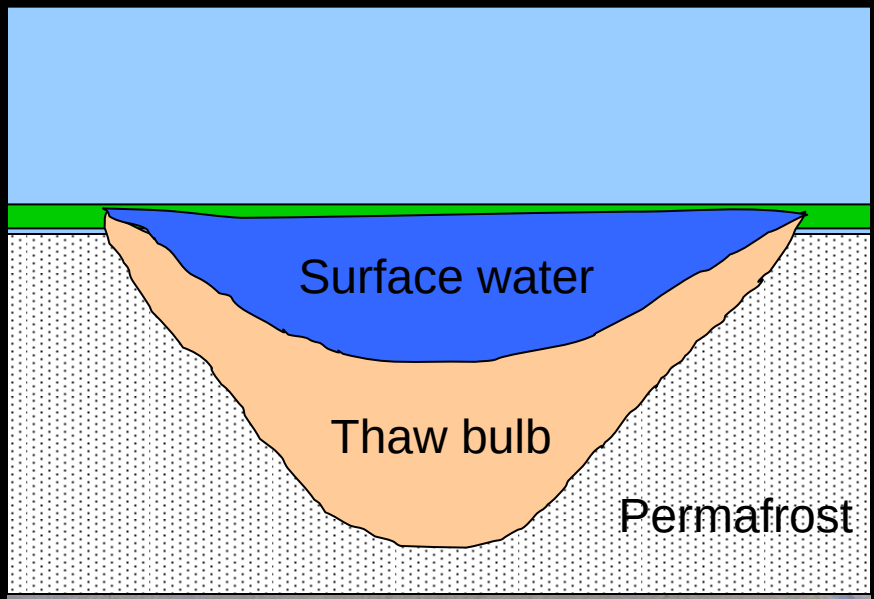
Temperature

Precipitation

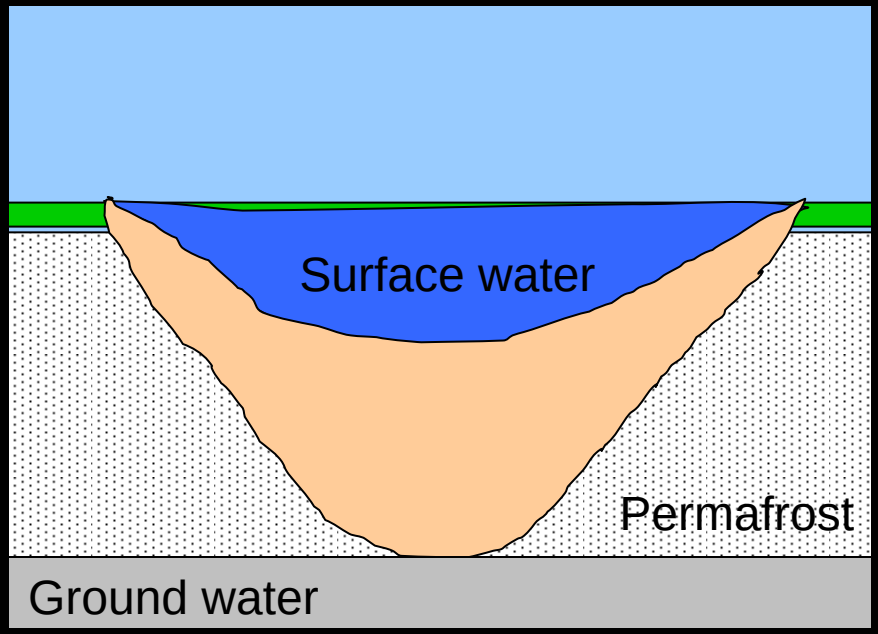
- Ice rich permafrost prevents the percolation of water into ground water maintaining lakes despite low annual precipitation



Permafrost degradation

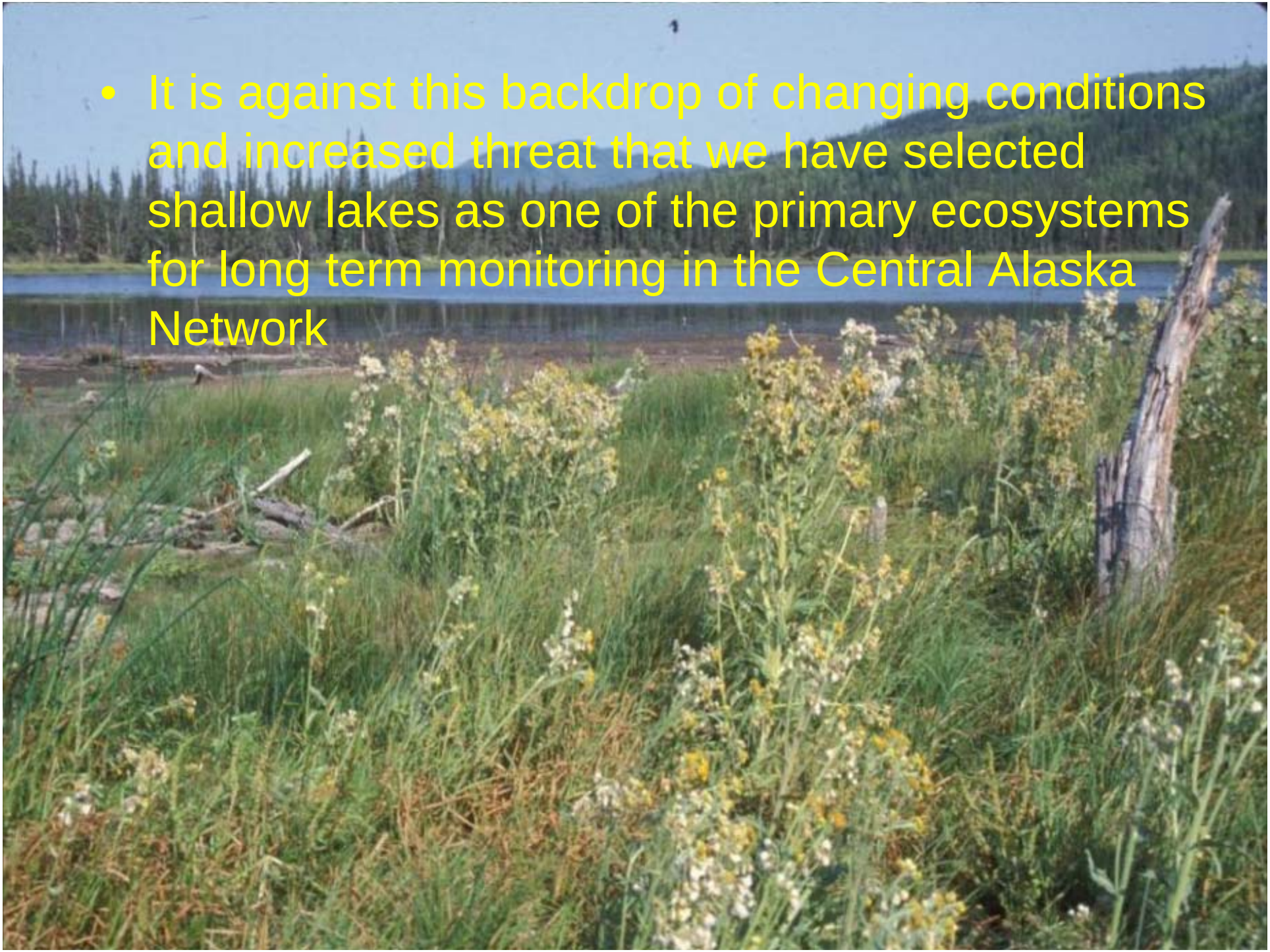


Changes that result from permafrost degradation



Permafrost in interior Alaska is sensitive to degradation

- Permafrost is discontinuous
- Close to freezing temperature
- Influenced by fire and ground disturbance


• It is against this backdrop of changing conditions and increased threat that we have selected shallow lakes as one of the primary ecosystems for long term monitoring in the Central Alaska Network

Vital signs to be monitored in shallow lakes

- Water quantity
- Water chemistry
- Macroinvertebrate abundance and composition
- Vegetation composition and abundance

Measurable Objectives for CAKN Shallow Lake Monitoring

Detect decadal scale trends in:

- Area, distribution, and number of shallow lakes and ponds
- Water chemistry
- Structure and composition of vegetation
- Macroinvertebrate taxa richness and relative abundance

Overall Sampling Design

- Network wide approach to better monitoring water quality
- understand how lakes vary across the landscape
- Sacrifice depth for breadth

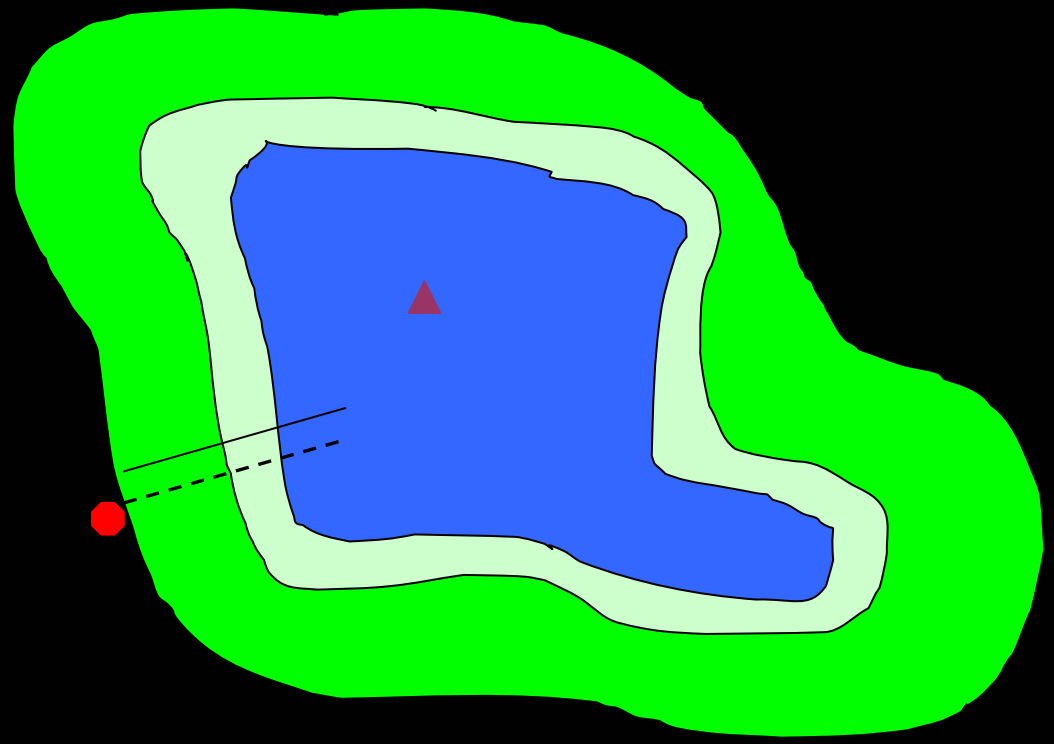
Overall Sampling Design cont.

- Randomly select lakes from population (>1 ha)
  - Up-weighted if within 2km of navigable water
  - Or floatplane accessible
- Sample each lake for two consecutive years (help explain inter-annual variation)
- Lay off for 10 years
- Resample

Within Lake Sampling Design

- Emergent zone
- Submergent zone
- Open water
- Permanent benchmark
- Water sampling site

- Vegetation sampling transect
- Macroinvertebrate sampling transect

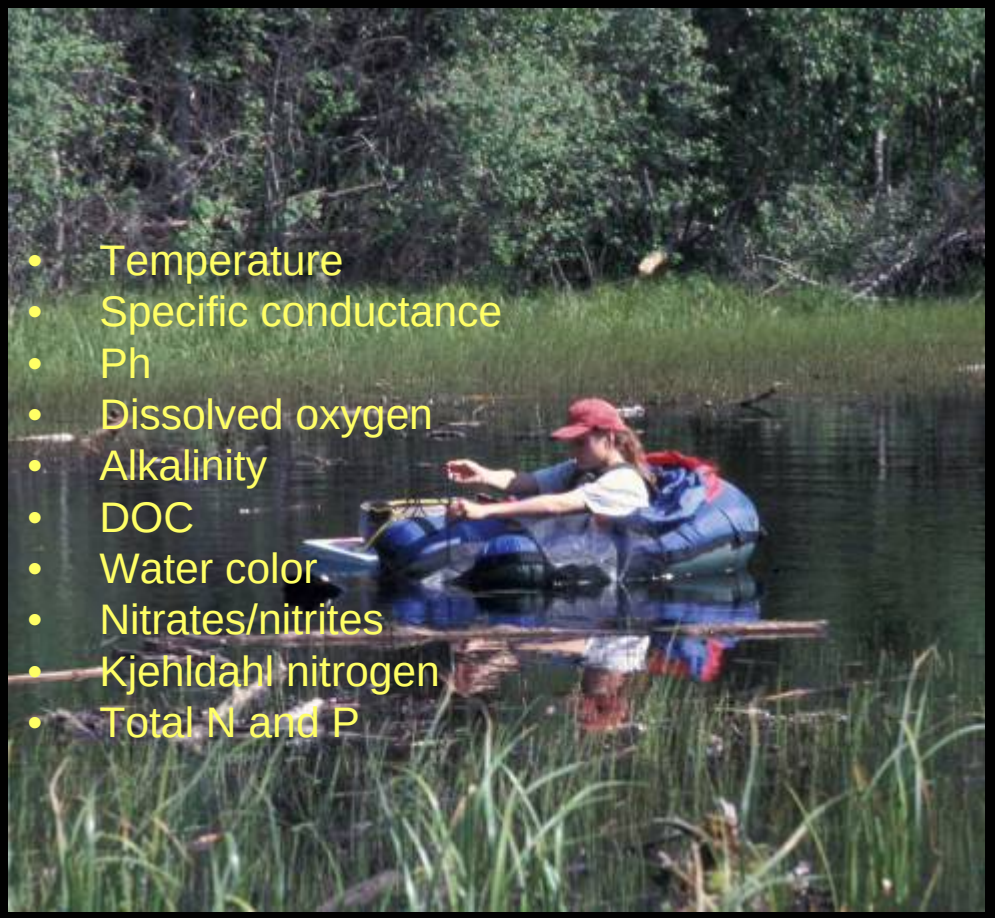


Measures of water quality

•Basic chemical properties can help us understand types of lakes found in the network

•Tell us about the chemical signature of a lake basin

•Indicate changing conditions over time



Measures of Trophic State

- Inform us about the biotic communities present
- Indicators of anthropogenic impacts
  - Chlorophyll *a*
  - Secchi depth
  - Total nitrogen
  - Total phosphorus

Macroinvertebrate Assessments

Good candidates for monitoring:

- Virtually ubiquitous
- Abundant
- Easy to collect
- Methods well developed
- Response to changing conditions well understood
- Relatively immotile
- Closely tied to sediments

- Species composition
- Relative abundance
- Richness, evenness
- Dominance
- Functional feeding guilds

Vegetation Assessments

- Virtually ubiquitous
- Respond quickly to changing water levels
- Ecological tolerances are known for many species
- Taxonomy well known

- Species composition
- Percent cover
- Width of the emergent zone
- Width of the submergent zone

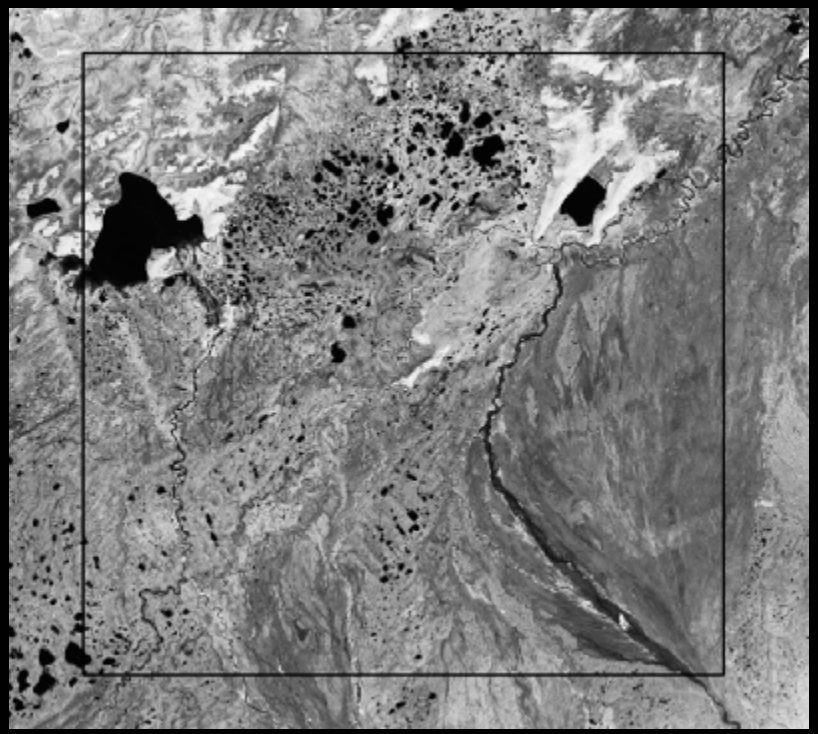
Physical factors

- Water depth
- Relative water level
- Bottom type/sediment composition

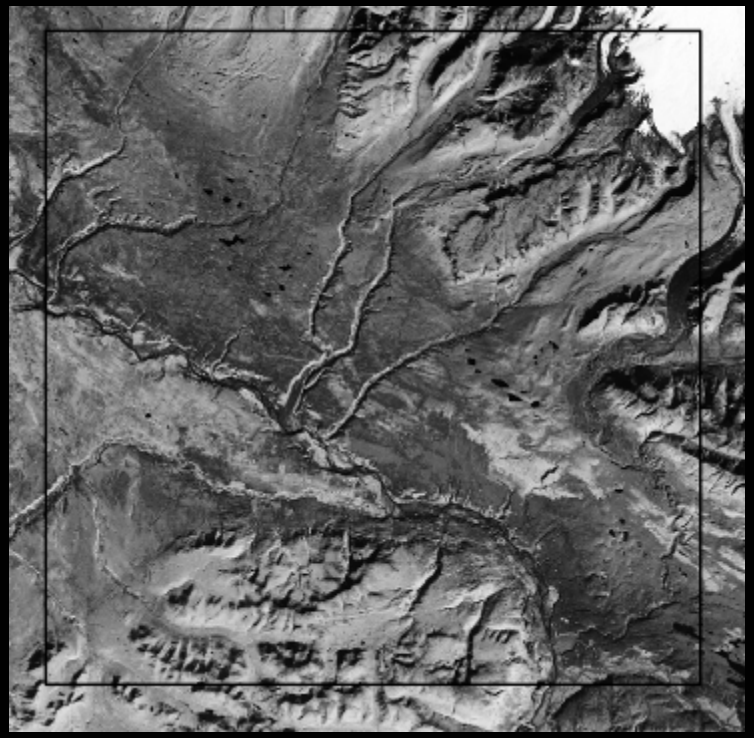
Two-phased approach

1. Retrospective analysis- 1 time effort
2. Long-term monitoring component - annually

Denali

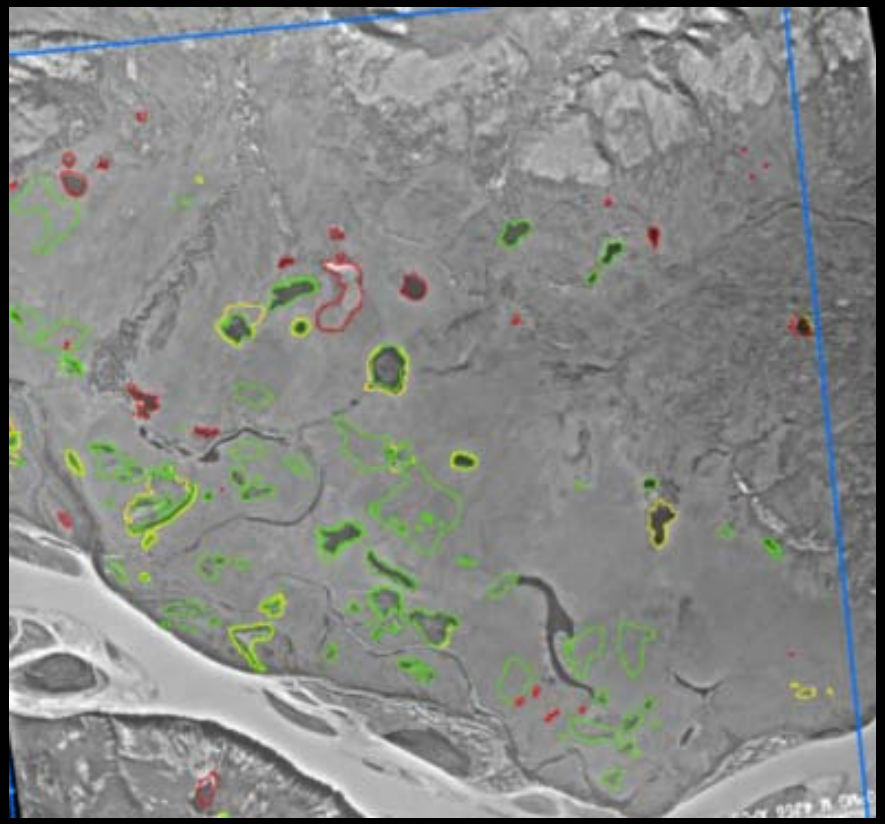


Wrangell-St. Elias



Ancillary Data

Permafrost monitoring



Weather monitoring


Thanks for your
attention I’d be happy
to answer questions